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Summary

A grazing study was conducted at the Gudmundsen Sandhills Laboratory, Whitman, Neb., to evaluate the effects of mixtures of wet distillers grains (WDGS) and straw or hay on grazed forage intake. There was no difference in ADG between the control and 70% hay/30% WDGS; however, steers supplemented with 60:40 blends of straw or hay with WDGS had higher ADG than the other two treatments. Range forage intake was decreased by 44% to 54% when steers were supplemented with the mixes. Feeding a mixture of WDGS and low-quality harvested-forage to cattle grazing rangeland may allow increasing stocking rate without decreasing animal performance.

Introduction

The increasing value of rangelands has led producers to look for alternatives that allow stocking rates to increase without needing additional land. With increased production of ethanol in Nebraska, the supply of wet distillers grains plus solubles (WDGS) is increasing, making the prices competitive relative to rangeland forage. Because intake in grazing situations is limited by fill, replacement of grazed forage using low-quality harvested forages mixed with WDGS to increase palatability seems to be a good way to increase carrying capacity or provide additional forage in years affected by drought. Previous research has shown mixing WDGS with wheat straw decreased grazed forage intake and improved animal performance (*2008 Nebraska Beef Cattle Report*, pp. 29-31; *2010 Nebraska Beef Cattle Report*, pp. 19-21). However, low-quality hay is more readily available than wheat straw in the Sandhills. The objective of our study was to determine the effect of supplementing WDGS mixed with low-quality hay compared to wheat straw on range forage replacement and animal performance.

Procedure

The experiment was conducted during the summer of 2009 at the University of Nebraska Gudmundsen Sandhills Laboratory located near Whitman, Neb. Treatments were assigned randomly to 20 paddocks and consisted of: 1) control (CON) at the recommended stocking rate (0.7 AUM/acre), 2) double stocked (1.32 AUM/acre) and supplemented with a mixture of 60% straw and 40% WDGS (STRAW), 3) double stocked (1.37 AUM/acre) and supplemented with 60% hay and 40% WDGS (LOHAY), and 4) double stocked (1.36 AUM/acre) and supplemented with 70% hay and 30% WDGS (HIHAY).

Forty summer-born yearling steers (712 ± 75 lb initial weight) were stratified by BW and assigned randomly to treatment, using five steers per replication (two blocks). Steers were limit fed a mixture of 60% hay and 40% WDGS at 2% of BW daily for five days to eliminate variation due to gut fill, and weighed for three consecutive days at the beginning and at the end of the trial. The averages of the three-day weights were used as the initial and ending body weights. Cattle in the control treatment received 0.8 lb/day of a protein supplement to meet their metabolizable protein requirements, composed of 50% soypass, 45% corn gluten meal, and 5% molasses. The WDGS and hay or straw were mixed in a vertical mixer and stored in silage bags for 30 days prior to the initiation of the trial. Cattle in the supplemented treatments were offered 8 lb/steer DM daily of the mixes in feed bunks located next to the paddocks to accurately measure any feed refusals.

The experiment was replicated over two blocks based on location (east and west) due to variations in species composition and topography. Within a block, each treatment was applied to five paddocks that were rotationally grazed, with a single occupation per paddock, during the experimental period of 68 days from June 18 to Aug. 26, with days of grazing per paddock adjusted to account for stage of plant growth. The control paddocks had 2.4 acres while the paddocks grazed at double stocking rates were divided in half on a diagonal with a temporary electric fence to decrease area of grazing, allowing the cattle to graze 1.2 acre per grazing period.

At the conclusion of grazing of each paddock, standing crop was determined by clipping all standing vegetation at ground level in 5 randomly placed quadrats (2.69 ft^2) in each paddock. Samples were sorted by live grass, standing dead grass, forbs, shrubs, and litter. Samples were dried in a forced air oven for 48 hours at 60°C. Forage quality IVOMD, CP, and NDF were analyzed from extrusa samples collected from each paddock at midpoint of grazing period using esophageally fistulated cows. *In vitro* organic matter digestibility was determined using the Tilley and Terry method (1963) modified by the addition of 1g/L of urea to the McDougall's buffer. Two separate *in vitro* runs were conducted and five forage standards of different qualities and known *in vivo* OM digestibilities were included in all of the IVOMD runs. To correct the IVOMD to *in vivo* values, regression equations were generated for each run, by regressing the IVOMD values of the standards

Table 1. Animal performance.

	Control	High	Low	Straw	SE	*P*-value
Initial BW (lb)	722	720	727	706	26.16	0.95
Ending BW (lb)	795	797	823	798	24	0.82
ADG (lb)	1.08[a]	1.13[a]	1.42[b]	1.40[b]	0.11	0.04

[a,b]Different letters represent differences between treatments ($P < 0.05$).

Table 2. Forage quality by paddock (time)[1]

Item	1	2	3	4	5	SE	*P*-value
IVOMD %	55[a]	54[ab]	53[ab]	52[b]	53[ab]	0.71	0.03
NDF %	73[ab]	73[ab]	68[a]	73[ab]	78[b]	2.97	0.04
CP %	8.8[a]	9.1[a]	7.7[b]	7.1[b]	6.8[b]	0.32	<0.001

[1]Sequence of grazing of paddocks, June 18 to Aug. 26.
[a,b]Different letters represent differences between treatments ($P < 0.05$).

on their known digestibilities.

Range forage intake was estimated using the 1996 beef NRC model. The model uses net energy content of the diet in conjunction with feed intake to predict animal performance. Therefore, if animal performance and energy values of the supplements and range forage consumed are known, range forage intake can be predicted. Data for animal ADG, supplement intake, and energy content of the supplements were obtained from the trial. Net energy for maintenance and gain were calculated from *in vitro* estimates of TDN using the NE equations in the Beef NRC. All data were analyzed using the MIXED procedure of SAS (SAS Inst. Inc., Cary, N.C.).

Results

Similar ADG was observed for the CON and HIHAY treatments ($P = 0.46$); however, steers in the LOHAY and STRAW treatments showed significantly higher ADG than the steers in the CON ($P < 0.05$). Steers in the LOHAY and STRAW treatments also outgained HIHAY treatment steers by 0.28 lb and 0.26 lb per day, respectively ($P < 0.05$; Table 1). These data show animal performance was either not affected or improved when supplementing with low-quality forage mixed with WDGS.

Range forage quality was not affected by supplementation treatment. During the grazing period, average values of 54%, 73%, and 7.9% were found for IVOMD, NDF, and CP, respectively. Table 2 shows the variation in range forage quality through the grazing season. IVOMD decreased during the grazing period, with highest value observed early in the season in the first paddock (55%) and the lowest towards the end of the season in the fourth paddock (52%). Variation in NDF did not show a consistent pattern, decreasing from 73% to 68% from paddock 1 to 3 and then increasing again to 78% from paddock 3 to 5 ($P < 0.05$). Average percentages of CP tended to decline during the grazing period, with 8.8% and 9.1% early and 7.7%, 7.1% and 6.8% late ($P < 0.05$). From these results it can be observed that forage quality decreased later in the growing season. This could be attributable to the fact that nutrient content decreases as the plant becomes more mature later in the growing season, and also to the large amount of rainfall that occurred during the experimental period, which caused the forage to grow and mature even more rapidly, increasing forage availability but decreasing forage quality.

Daily range forage and supplement intakes are presented in Table 3. Supplementation with a low-quality harvested forage and WDGS reduced intake of range forage by 54%, 48% and 44% for the HIHAY, STRAW, and LOHAY treatments, respectively, compared to the CON. A difference also was detected between the HIHAY and LOHAY treatments; steers offered the mix with higher proportion of hay consumed 26% less grazed forage than the animals in the LOHAY treatment. Grazed forage intake for steers in the STRAW treatment was intermediate between the LOHAY and HIHAY treatments. Consumption of the supplement was not different among treatments, with steers consuming 0.92% BW of the mixes. Total DMI was similar among treatments, varying between 17.8 lb and 15.8 lb — the highest value for the CON and the lowest for the HIGH treatment. Considering the amount of range forage replaced and the amount of supplement consumed by the supplemented treatments, we calculate that 1 lb of the HIHAY, LOHAY, and STRAW treatments replaced 1.28 lb, 1.11 lb, and 1.18 lb of range forage, respectively.

The amount of standing crop after the paddocks were grazed was significantly higher for the CON than for the other three treatments ($P < 0.05$); however, there was not a significant difference among the supplemented treatments (Table 3). Since the stocking rates were doubled in the supplemented groups, less standing crop might be expected for these groups. However, our objective was to replace range forage with the mixtures of hay (straw) and WDGS. The lower standing crop at conclusion of grazing indicates we were not completely successful. Perhaps more of the mixtures should have been fed. On average, the mixtures were 44% of total intake.

Total NDF consumed was examined to see if it had an effect on DMI (Table 3). Diets composed of forages are thought to be limited by physical distention in the gastrointestinal tract. When NDF from total DMI was considered, steers in the CON treatment showed higher NDF intake (12.9 lb) than the steers in the supplemented groups;

(Continued on next page)

however, NDF intake was similar among the HIHAY, LOHAY and STRAW treatments (10.7, 11.3, and 11 lb respectively). Even though NDF intakes between supplemented and control treatments were not the same, there could have been a similar filling effect, since a great percentage of the NDF in supplemented groups came from hay and wheat straw that are composed mainly of stems, which are more bulky than grazed forage.

The findings of this study show mixing WDGS with low-quality forage is an effective tool to increase stocking rates without hurting animal performance, and the reduction in intake increased with the level of fiber in the supplement. From these results the 70:30 blend seems to be the best combination to get the higher amount of grazed forage replacement.

Table 3. Range forage, mix, and NDF intake, and standing crop residue.

	Control	HIHAY	LOHAY	Straw	SE	*P*-value
Range forage intake (lb)	17.8	8.3	9.9	9.4		
Mix intake (lb)	0	7.5	7	7.2		
Total DM intake (lb)	17.8	15.8	16.9	16.6		
NDF intake (lb)	12.9	10.7	11.3	11		
Standing crop (lb/acre)	980[a]	707[b]	729[b]	707[b]	47	0.0013

[a,b]Different letters represent differences between treatments ($P < 0.05$).

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